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OPPOSITION AND THE SYLLOGISM

IN our text-books of logic the topics of opposition and the syllogism are treated as if they were only externally connected with each other. Opposition is regarded as a relation between two propositions, and the syllogistic implication is regarded as a relation between three propositions, so that the two relations are made radically distinct. I wish to show that the syllogistic relation is very closely allied to that of opposition. In what I shall have to say on the subject there is nothing new. But it is my hope that a new mode of presentation may set in clearer light some truths which have often been misunderstood.

As a preliminary, let us consider the following table of the propositions having as subjects S or non-S and as predicates P or non-P. In the table equivalent propositions are grouped together; and they may be derived from each other in the given order, by obversion or simple conversion.

I	II	III	IV
All S is P	All S is non-P	All non-S is non-P	All non-S is P
No S is non-P	*No S is P*	No non-S is P	No non-S is non-P
No non-P is S	No P is S	No P is non-S	No non-P is non-S
All non-P is non-S	All P is non-S	All P is S	All non-P is S

V	VI	VII	VIII
Some S is-not P	Some S is-not non-P	Some non-S is-not non-P	Some non-S is-not P
Some S is non-P	*Some S is P*	Some non-S is P	Some non-S is non-P
Some non-P is S	Some P is S	Some P is non-S	Some non-P is non-S
Some non-P is-not non-S	Some P is-not non-S	Some P is-not S	Some non-P is-not S

On account of the equivalence of the propositions in each group, it is possible and convenient to consider the relation of opposition as subsisting between the several groups, instead of merely between the separate propositions. In stating the relations between the groups, I shall use the expression "the terms of the group," meaning thereby the terms which appear in its *symmetrical* propositions, *i. e.*, the universal negative and particular affirmative forms. We may then say:

1. *A universal and a particular group having the same terms are contradictory.* Both can not be true and both can not be false. Thus I. and V., II. and VI., III. and VII., and IV. and VIII. are contradictory.

2. *Two universal groups having one term in common are contrary;* that is to say, *if their common term is not null, both can not be true.* Thus I. and III. are contrary to II. and IV. More precisely,

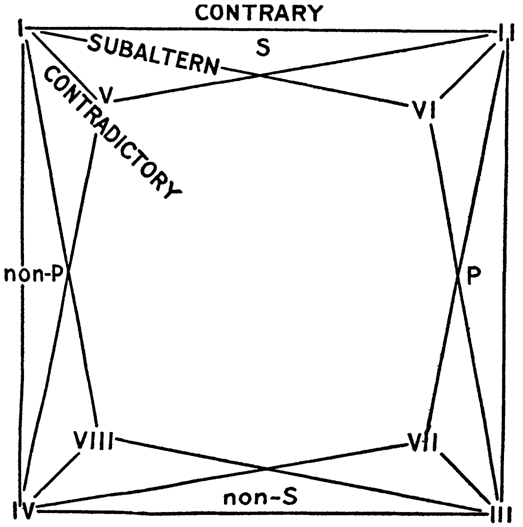
> If any S exists, I. and II. can not both be true.
> If any non-P exists, I. and IV. can not both be true
> If any P exists, II. and III. can not both be true.
> If any non-S exists, III. and IV. can not both be true.

3. *A particular group having one term in common with a universal group is subaltern to it;* that is to say, *if the common term is not null the universal implies the particular.* Thus VI. and VIII. are subaltern to I. and III., and V. and VII. are subaltern to II. and IV. More precisely,

> If any S exists, I. implies VI., and II. implies V.
> If any non-P exists, I. implies VIII., and IV. implies V.
> If any P exists, II. implies VII., and III. implies VI.
> If any non-S exists, III. implies VIII., and IV. implies VII.

All these relations are indicated in the accompanying "square of opposition." Contradictories are placed together at the corners. Universals at adjacent corners are contrary. A particular is subaltern to a universal at an adjacent corner. The term upon which contrariety and subalternation depend is written between. If one wishes to recall from the diagram the meaning of the numbers, I., II., etc., one needs only in each case to put together the two nearest terms into a universal negative or particular affirmative proposition. Thus for I. we may write, No non-P is S; for VII., Some non-S is P. The equivalent forms may then be gotten by obversion and simple conversion.

Several comments suggest themselves. If we analyze any particular proposition of the form, Some S is P, we find that it implies that there exists an individual that belongs both to the class S and to the class P. There may be more than one such individual, but there must be at least one. But the universal proposition, All S is P, may be true, even though the subject-class (or indeed both classes) be null. In fact, as Professor Royce has recently had occasion to remind us, in that case the proposition must be true. "All trespassers will be prosecuted," is not refuted, but verified, if no trespass is committed. To be sure, the context often shows that the existence of the subject is to be taken for granted. But in numberless instances we assert universal propositions when we are *ignorant* whether the subject-class is null or not—less often, of course, when we know it to be null. Hence, for the sake of clearness, when the existence of the subject is to be assumed this must be set down in the formulæ; for example: Some S exists, and all S is P.[1]



Sometimes this distinction between universal and particular propositions has been beclouded by the contention that universal propositions too have a certain existential import—that all propositions are characterizations of reality, or of some universe of discourse. This contention is just. But one truth does not rub out another; and it still remains true that universal propositions need not imply that their subject-classes are not null.

For this reason, in all the forms of inference where a particular proposition is derived from one or more universal propositions (aside from one exception, to be noted), an additional existential proposition is covertly taken for granted. That this is the case with the derivation of the subaltern, we have just noted; and we shall hereafter have occasion to note that the like is true of those modes of the syllogism (*Darapti, Felapton, Fesapo,* and *Bramantip,* as well as the so-called "subalteran modes"), in which two universal premises give a particular conclusion.[3] The same principle applies to conversion *per accidens* and (consequently) to inversion. The former is valid only when the original subject is not null, the latter only when the negative of the original predicate is not null. Thus the proposition, All S is P (in group I.), implies that some P is S (group VI.) only on condition that some S exists; and the same premise implies that some non-S is non-P (group VIII.) only on condition that some non-P exists. In the case of inversion the fallacy that results from the neglect of this condition is sometimes startling. All wise men are mortal, may be held to imply that some unwise men are immortal; but this is correct only on the condition that some immortal men exist.[4] I should think that it would be possible for the authors of our elementary text-books to give in simple English a correct account of this whole matter.

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[1] On the other hand, in the rare instances when we assert propositions of the form, Some S is P, conditionally, without meaning to imply the existence of any S, this too must be made explicit in the formula: If any S exists, some S is P.

[2] I believe that this observation was first made by the American logician, Miss Ladd, whom we know now by a different name.

[3] In the first three the middle term, in *Bramantip* the major term, and in the subaltern modes the minor term, must not be null. It has sometimes been

All the exceptions (so far as I am aware) to the rule that universal premises can not give particular conclusions rest upon the fact that from the proposition, No S exists, we can infer: Some non-S exists. Here, indeed, we assume that U (the universe of discourse) is not null; and the inference can be put in the form: No U is S, and some U exists, therefore some U is non-S. But as a matter of fact the assumption that the universe of discourse is not null is everywhere made; and every attempt to deny it or even question it involves the bringing in of a new and larger universe, as if we should say: No V is U; and in that case we have a new non-S as well. Hence this assumption can not be laid particularly to the charge of the inference in question. What we can say is that in this case the omnipresent assumption becomes explicit.[5]

Let the class which consists of the individuals common to the classes S, P, M, N, etc. (the so-called "logical product"), be denoted by the expression S.P.M.N., etc. In what follows I shall assume that in such an expression the order of the factors is immaterial, and also that the factors may be grouped together *ad libitum*. Thus it

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held that in all syllogisms the existence of the middle term is assumed. That this, however, is an error appears very clearly in the case of *Camestres:* All angels have hands and wings, no vertebrates have hands and wings, therefore no vertebrates are angels. This is valid, even though we be quite ignorant whether any angels or other creatures with hands and wings exist, or not.

[4] Keynes, whom a recent writer in this JOURNAL severely criticizes for his treatment of inversion, gives explicit mention to this condition ("Formal Logic," p. 159). On the other hand, Aikins ("The Principles of Logic," p. 138) goes too far in saying: "The process of alternate obversion and conversion . . . is valid only if the existence of all the objects named is presupposed." For obversion and simple conversion are unconditionally valid.

[5] It is thus that from the premises, All S is P, No S is P, and All P is S we can infer: Some non-S is non-P. The first two, being contraries, imply that no S exists; wherefore some non-S exists. But this is the condition that the third premise implies the conclusion as its subaltern.

will be assumed that S.P.M.N is the same class as P.N.M.S, or (P.M).(N.S), or (N.S.M.).P.

It is then to be observed that any universal proposition can be put into the form: No S exists; and that any particular proposition can be put into the form: Some S exists. For example the propositions of group I. above may be expressed: No S. non-P exists: and those of group VII. may be expressed: Some non-S.P. exists. And the relations of contrariety and subalternation may be expressed:

If no S.P exists, and no S.non-P exists, then no S exists.
If no S.P exists, and some S exists, then some S.non-P exists.

On the other hand, any proposition in the positive or negative existence-form can be translated into the subject-predicate form. Thus, No S.P.Q exists, may be rendered as No S is P.Q, or as No S.P is Q, or as No S.Q is P. Similarly: Some S.P.Q exists, may be rendered as: Some S is P.Q, etc. The single-factored propositions: No S exists, and Some S exists, may be put in the form: No U is S, and Some U is S (where U signifies the universe of discourse).

There are two principles of immediate inference, which are in constant use, but which our text-books seldom recognize. These are: (1) Any factor may be added to a distributed term of a proposition; and (2) any factor may be dropped from an undistributed term. Thus, if all S is P, it follows that all S.M is P; and if some S is P.Q, it follows that some S is P. As applied to propositions in the negative and positive existential form, the principles read: (1) Any factor may be added to a universal proposition; and (2) any factor may be dropped from a particular proposition. If no S.P exists, then no S.P.Q exists; and if some S.P.Q exists, some S.P exists.

It is by means of these principles that we shall be able to show the connection between the syllogism and opposition.

1. Consider the premises:

No P.M exists.
No S.non-M exists.

Let us add the factor S to the first and the factor P to the second. (Permit me to emphasize, in passing, the fact that these operations upon the two premises are mutually independent; that is to say, each can be performed without assuming the truth of the other premise.)

No (S.P).M exists.
No (S.P).non-M exists.

But these two propositions are contraries; and hence since both are true, their common term must be null. That is to say:

No S.P exists.

We have thus "reduced" the syllogism in *Cesare* to the principle of contrary opposition. Of course, the same process might be carried through with propositions in the subject-predicate form, and it can be applied to any of the moods in which a universal conclusion is obtained. Take, for example, the premises of *Barbara:*

All M is P.
All S is M.

Obvert and convert simply the major premise:

No non-P is M.

Introduce non-P into the subject of the minor premise, and S into the subject of the transformed major premise:

All S.non-P is M.
No S.non-P is M.

Since these are contraries we have:

No S.non-P exists.

Or, in subject-predicate form:

All S is P.

Nevertheless it is convenient to use the existence-forms, because their symmetry enables us to dispense with the consideration of figure.[6]

2. Consider the premises:

No P.M exists.

Some S.M exists.

Adding the factor S to the first, we obtain:

No (S.M).P exists.

From this and the second premise we obtain the subaltern:

Some (S.M).non-P exists.

And now, dropping the factor M, we have:

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[6] It is in this way that Mrs. C. L. Franklin proves her half-humorous thesis, that the conclusion of the syllogism in *Barbara* omits precisely *one half* of what is contained in the premises. We are asked to note that from the proposition: No P.M exists, we can derive the *two* propositions: No S.P.M exists and No non-S.P.M exists; and furthermore, that since these propositions are contraries, the two together imply the proposition: No P.M exists. Thus: No P.M exists, is exactly *equivalent* to those two propositions taken together. Similarly, the proposition: No S.non-M exists, is equivalent to the two propositions: No S.P.non-M exists and No S.non-P.non-M exists. Thus the two syllogistic premises: No P.M exists and No S.non-M exists, are equivalent to the *four* propositions: (1) No S.P.M exists; (2) no non-S.P.M exists; (3) no S.P.non-M exists; and (4) no S.non-P.non-M exists. But (1) and (3) are together equivalent to the conclusion: No S.P exists; while no account is taken, in the conclusion, of the two other propositions, (2) and (4).

Some S.non-P exists.

3. Consider the premises:

No P.M exists.
No S.M exists.

Let us suppose that in addition to these premises we may assume:

Some M exists.

From this last and the second premise, we obtain the subaltern:

Some non-S.M exists.

This, with the first premise, gives us (by the method shown above):

Some non-S.non-P exists.

4. Consider once more the premises:

No P.M exists.
No S.non-M exists.

Suppose that we are entitled to assume:

Some P exists.

This last, with the first premise, gives us the subaltern:

Some P.non-M exists.

This, with the second premise, gives us (by the preceding method):

Some P.non-S exists.

We have now derived the following four syllogistic formulæ:

1. If no P.M exists, and no S.non-M exists, then no S.P exists.
2. If no P.M exists, and some S.M exists, then some S.non-P exists.
3. If no P.M exists, and no S.M exists, then some non-S.non-P exists, on the condition that some M exists.
4. If no P.M exists, and no S.non-M exists, then some P.non-S exists, on the condition that some P exists.

Of these formulæ, (1) is equivalent to *Barbara, Celarent, Cesare, Camestres,* and *Camenes;* (2) is equivalent to *Darii, Ferio, Festino, Baroko, Disamis, Datisi, Bokardo, Ferison, Dimaris* and *Fresison;*[7] (3) is equivalent to *Darapti, Felapton,* and *Fesapo;* and (4) is equivalent to *Bramantip* and the so-called "subaltern" modes.

This completes the "reduction" of the moods of the syllogism. It is apparent, however, that formulæ (3) and (4) are not independent and do not describe simple syllogisms. All syllogisms may be obtained from (1) and (2). We may now, furthermore, observe that if we replace the conclusions of these two formulæ by their contradictories and interchange the symbols M and P in (2), they reduce to the common form:

Some S.P exists, no S.non-M exists, and no P.M exists, are not all true.

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[7] For example, the old enemy *Bokardo* becomes: Some M.non-P exists, no M.non-S exists, therefore some non-P.S exists.

This, then (if we leave out of account the possible occurrence of singular terms), is *the general principle of the categorical syllogism.*

Now, if we refer to the formulæ for the contrary and the subaltern (on p. 397), we at once perceive that these too can be reduced to a common form by replacing the conclusions by their contradictories:

Some S exists, no S.non-P exists, and no S.P exists, are not all true.

But *this is simply the principle of the syllogism* in the special case where S and P are identical (the symbol P being put here instead of M). From this point of view, therefore, we see that the inference of the falsity of the contrary and the truth of the subaltern constitute a simple variety of syllogism, although we deduced the principle of the syllogism by a particular application of the principle of opposition. This sort of "generalization" is, of course, not uncommon in the deductive sciences.[8]

The principle of the categorical syllogism may be compared with a similar principle of the hypothetical syllogism: It is false that the joint assertion of p and q is true, the joint assertion of p and not-r false, and the joint assertion of q and r false. If we observe, that to say that the joint assertion of two propositions is false, is equivalent to saying that each implies the falsity of the other, we may interpret this principle as declaring: If p implies r and r implies not-q, then p implies not-q. It may also be read as affirming that if q implies r, and p and q are both true, then p and r are both true.

In the case where p and q are the same proposition—a case which is thus analogous to the principle of the contrary and the subaltern—we have: It is false that p is true, the joint assertion of p and not-r, false, and the joint assertion of p and r, false. This yields the principle of the *reductio ad absurdum:* If p implies both r and not-r it is false. And it also yields the principle of the *modus ponens* (from which the *modus tollens* is easily derived): If p implies r, and p is true, then r is also true.

If we use letters to denote ambiguously either classes or propositions, the two general principles (of the categorical and the hypothetical syllogism) may be expressed in a single symbolic formula:

$$-[(S.P).-(S.-M).-(P.M)].$$

And in the same way the principle of the contrary and the subaltern, and the principle of the *reductio ad absurdum,* and the *modus ponens,* may be expressed in the one formula:

$$-[S.-(S.-P).-(S.P)].$$

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[8] For example, in elementary geometry we first find the sum of the interior angles of a triangle; and then by the application of this result we find the formula for the sum of the interior angles of any polygon.